Presentation to

JUSTSAP 2010

Dr. Daniel Rasky
NASA Ames Research Center

Sustainable Settlement Beyond Low-Earth-Orbit

An Exciting Future with Many Participants

Human Space Flight and Exploration

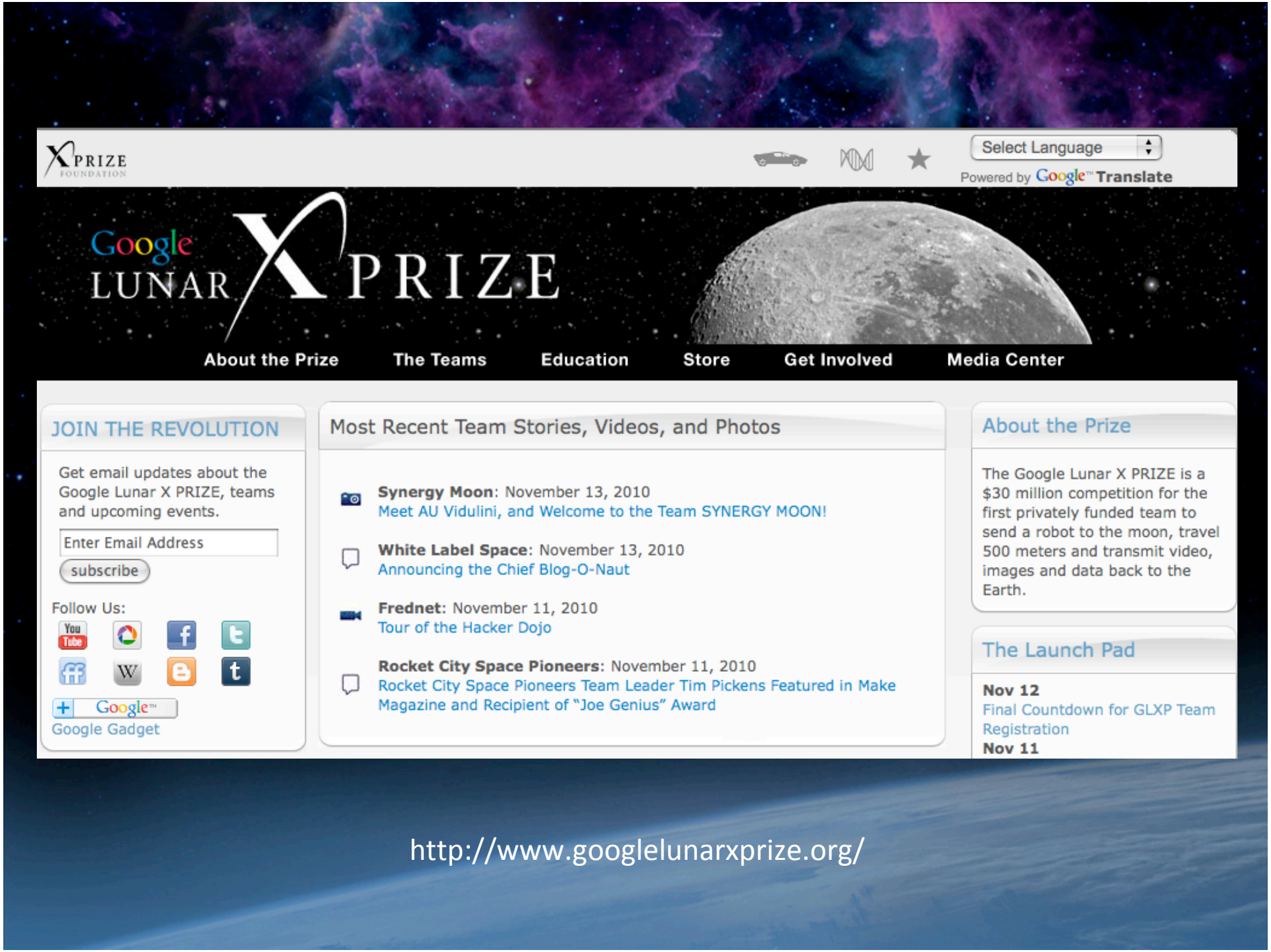
"The long term goal of the human space flight and exploration efforts of NASA shall be to

expand permanent human presence beyond low-Earth orbit

and to do so, where practical, in a manner

involving international partners."

(Excerpts from PL 111-267 Sec. 202(a))



http://www.googlelunarxprize.org/

NASA Awards Contracts For Innovative Lunar Demonstrations Data

- WASHINGTON -- NASA has awarded contracts to six companies for the purchase of technical data resulting from industry efforts to develop vehicle capabilities and demonstrate end-to-end robotic lunar landing missions.
- The data from these contracts will inform the development of future human and robotic lander vehicles and exploration systems.
- The ILDD Broad Agency Announcement resulted in multiple award firm-fixed price indefinite-delivery/indefinite-quantity contracts with a total value of up to $30.1 million over a period of up to five years.
- For each selected contractor, the minimum government purchase is $10,000, and the maximum government purchase is $10.01 million.
- The contracts were awarded to:
    1. Astrobotic Technology Inc., Pittsburgh, Pa.
    2. The Charles Stark Draper Laboratory, Inc., Cambridge, Mass.
    3. Dynetics Inc., Huntsville, Ala.
    4. Earthrise Space Inc., Orlando, Fla.
    5. Moon Express Inc., San Francisco
    6. Team FREDNET, The Open Space Society, Inc., Huntsville, Ala.

http://www.nasa.gov/centers/johnson/news/releases/2010/H10-259.html

National Aeronautics and Space Administration

FIND IT @ NASA: + GO

NASA LUNAR SCIENCE INSTITUTE

CURRENT MOON

Waxing Gibbous
70% of Full
Mon 15 Nov, 201(
11:35:58 AM

lunar phase

Follow us:

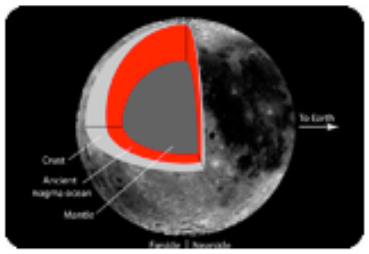
- HOME
- ABOUT NLSI
- TEAMS
- INTERNATIONAL
- LUNAR SCIENCE
- EDUCATION

The NLSI brings together leading lunar scientists from around the world to further NASA lunar science and exploration

Events

2010 Dec 13: 2010 AGU Fall Meeting
2010 Dec 21: Total Lunar Eclipse!
2011 Jan 9: American Astronomical Society
2011 Mar 7: 42nd Lunar and Planetary Science Conference

News



FAR SIDE OF THE MOON EXPLAINED

Research suggests that when the lunar crust floated on an ocean of molten rock, tidal effects caused distortions that were later frozen in place.

http://lunarscience.arc.nasa.gov/

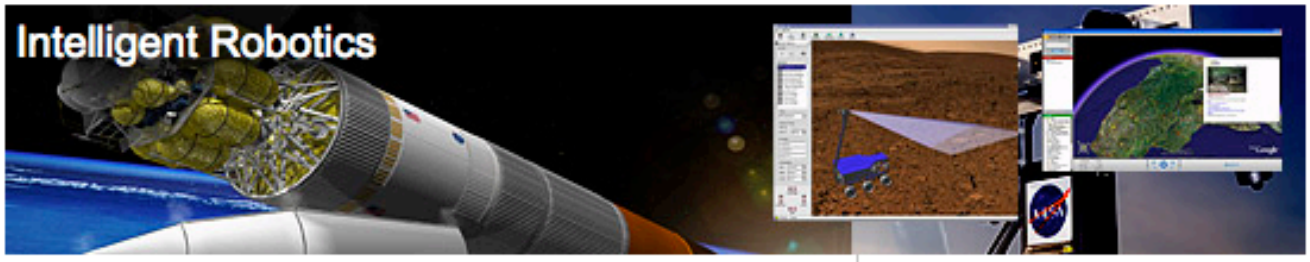
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Search: + GO

+ABOUT NASA | +LATEST NEWS | +MULTIMEDIA | +MISSIONS | +MY NASA | +WORK FOR NASA

+ NASA Home
+ Ames Home
+ Intelligent Systems Division
+ Autonomous Systems and Robotics

Intelligent Robotics



From July 26 to August 8, 2010, the Intelligent Robotics Group conducted a field test at Haughton Crater in the Canadian Arctic to study how human field work can be augmented with subsequent robot activity. For more information, click here!

Search Intelligent Systems Division

GO

NASA Ames Intelligent Robotics Group (IRG)

The Intelligent Robotics Group (IRG) explores extreme environments, remote locations, and uncharted worlds. We conduct applied research in computer vision, geospatial data systems, human-robot interaction, planetary mapping and robot software. (IRG brochure)

Team (2010 photo)

Group Lead
Terry Fong

Deputy Group Leads
Maria Bualat
Matthew Deans

Assistant Group Lead
Linda Kobayashi

Researchers
Mark Allan
Nick Bartos
Ross Beyer
Xavier Bouyssounouse
Michael Broxton
Tamar Cohen
Lorenzo Flückiger

http://ti.arc.nasa.gov/tech/asr/intelligent-robotics/

Activities for Fostering Commercial Space

Dan Rasky, PhD
Director
Emerging Commercial Space Office
NASA Ames Research Center

July 24th, 2010

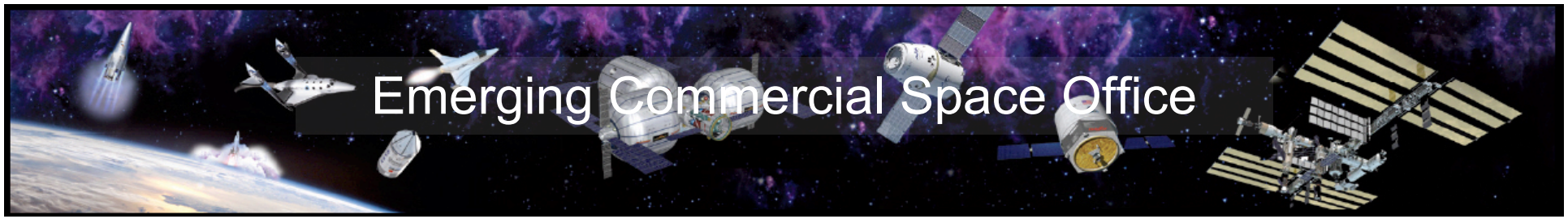
Emerging Commercial Space Office

- **The Emerging Commercial Space Office (ECSO) has been recently chartered** under the Office of Partnerships, Innovation and Commercial Space in Office of the Chief Technologist to support and promote U.S. leadership in the emergence of the new space economy
- **Will work with HQ and other Centers to foster emerging commercial space companies**
- **Legislative Authority is derived from the Space Act of 1958** (as amended) and other legislative enablers to:
  - Facilitate NASA's support of entrepreneurial space ventures for the good of the nation.
  - Leverage commercial capabilities into new areas that benefit NASA and the public and increase NASA's and the public's ability to use space for discovery, development, education, and applications.

"I now dream of the day when any American can launch into the vastness of outer space and see the magnificence and grandeur of our home planet, Earth, as I have been blessed to do." Charlie Bolden

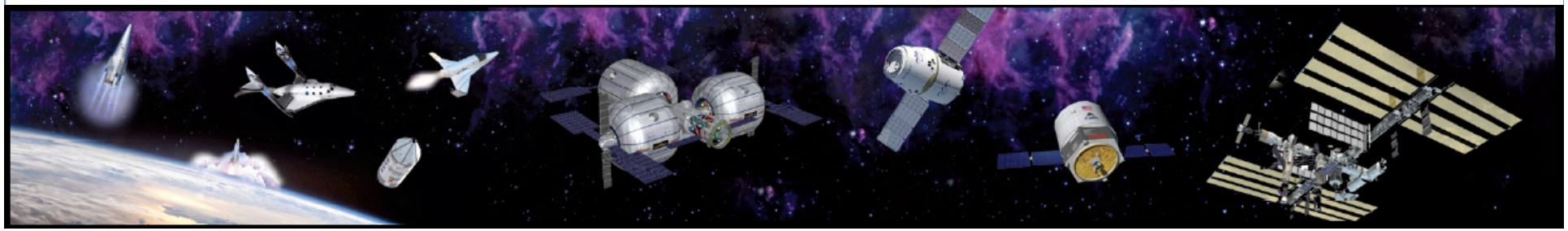
Initial Activities

- **Office will initially pursue three areas of activities** complementary to NASA's existing commercial space programs to create new opportunities for NASA, American commerce and public benefit:
  - **Lead and support special studies and activities for commercial space** such as the Commercial Reusable Launch Vehicle technology roadmap, and the *HQ Commercial Space Workshops*
  - **Help identify opportunities and integrate commercial space activities** into the program planning of the different NASA mission directorates and centers
  - **Support commercial space industry use of NASA expertise & facilities** through NACA-style consultation and assistance to commercial space companies



Ames Has Been a Strong Advocate of Emerging Commercial Space

- Original member of the Innovative Partnership Program Commercial Space Team
- **Hosted Five National Workshops on New Uses of Space**, including our first national meeting entitled “An Entrepreneurial Paradigm for the ISS” in June 2005, and the “ISS National Laboratory Workshop” in October, 2007
- Hosted the NewSpace Conference for 2009 & 2010, and have become the permanent host for this meeting
- Hosted the CRASTE 2010 meeting in collaboration with AFRL. 2011 CRASTE has expanded to include FAA as a partner.
- Provided critical program creation support and guidance for NASA’s Commercial Orbital Transportation Services (COTS) program
- Supported the Innovative Lunar Demonstration Data Program
- Support and participation in numerous commercial and emerging space forums: Space Investment Summits, ISDC, Space Access, AIAA Space 2006-9, FAA AST, NewSpace 2009-10, CRASTE 2009



Emerging Space Partners

Google

SPACEX

Virgin GALACTIC

XCOR AEROSPACE

Lunar Transportation Systems Inc

ECLIPTIC

PARAGON
SPACE DEVELOPMENT CORPORATION

Masten
SPACE SYSTEMS

ASTROBOTIC
Technology, Inc.

ODYSSEY
MOON

GRADATIM FEROCITER

Blue Origin

SCALED
COMPOSITES

CISCO

NASA Research Park at Ames Research Center

NASA Research Park: 2020 Campus Plan

NRP Collaborations Yield Entrepreneurial Partnerships & Innovation

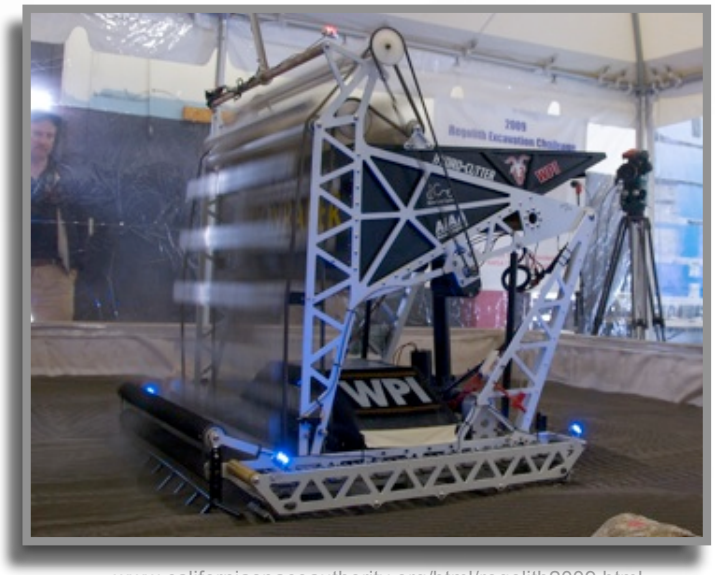
- NASA Research Park (NRP) is uniquely positioned in the heart of Silicon Valley as a nourishing and dynamic environment for cutting-edge research and education.
- Through this NRP initiative, NASA is creating:
  - A world-class shared-use R&D and education campus for industry, academia, non-profits, and government;
  - A center for innovation and entrepreneurship;
  - A unique community of scientists, engineers, students and educators with a shared mission.
- NRP provides a two-direction partnerships
  - Traditional NASA technology commercialization “out” to industry, and
  - Technology infusion “into” NASA by gaining access to knowledge and leading-edge technology from the external community.

Current NASA Research Park 15-year Plan

- Continue to bring in partners to use land, Moffett Federal Airfield and the Hangars surrounding the Airfield in a secure federal R&D context and in the context of the NRP.
  - Allows for remarkable potential synergy for the development of green technologies, airships and green aircraft, and operations.
  - Unique infrastructure for airship R&D, high-altitude wind power generation R&D.
- **A Center of Excellence for Sustainable Technologies (Clean Tech).**
  - Utilize unique system of hangars, eastside land and Airfield in the NRP to pursue critical national need with NRP industry partners.
- Many NRP partners are engaged in sustainable technologies, including fuel cells, airships, high-altitude wind power generation, land based wind power generation, personal rapid transit systems, UAVs, electric cars.
- Complement NASA Aeronautics emphasis on green aviation and green technology (including NASA project OMEGA).
- NASA Ames opening in 2011 new Platinum LEEDS most energy efficient building in the federal government.

2009 Regolith Excavation Challenge

October 17-18, 2009, NASA Research Park, Moffett Field, CA



www.californiaspaceauthority.org/html/regolith2009.html

Paul's Robotics-1st Place

Three teams awarded $750,000 in prize money for lunar robotic prototypes

Terra Engineering
2nd Place

Team Braundo-3rd Place

Team representation from 12 states & Canada

NASA participation from HQ, ARC, GRC, JSC, KSC

Competition was co-hosted by the California Space Education & Workforce Institute and the California Space Authority in collaboration with the NASA Lunar Science Institute and performed in a simulated lunar environment located in the NASA Research Park

Prize funding was provided by NASA Centennial Challenges Program

Remarks by NASA Administrator Charles Bolden

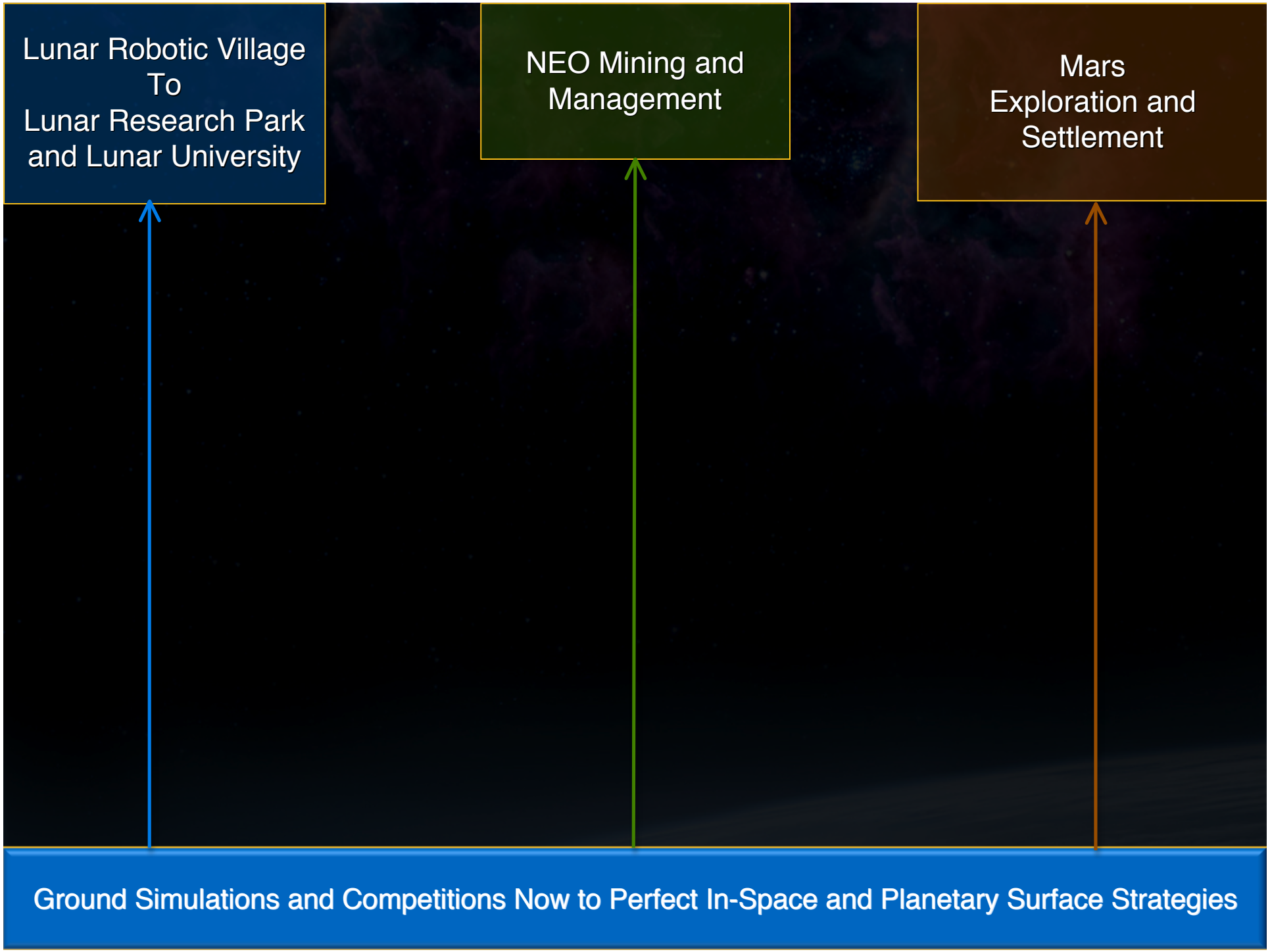
October 20, 2009

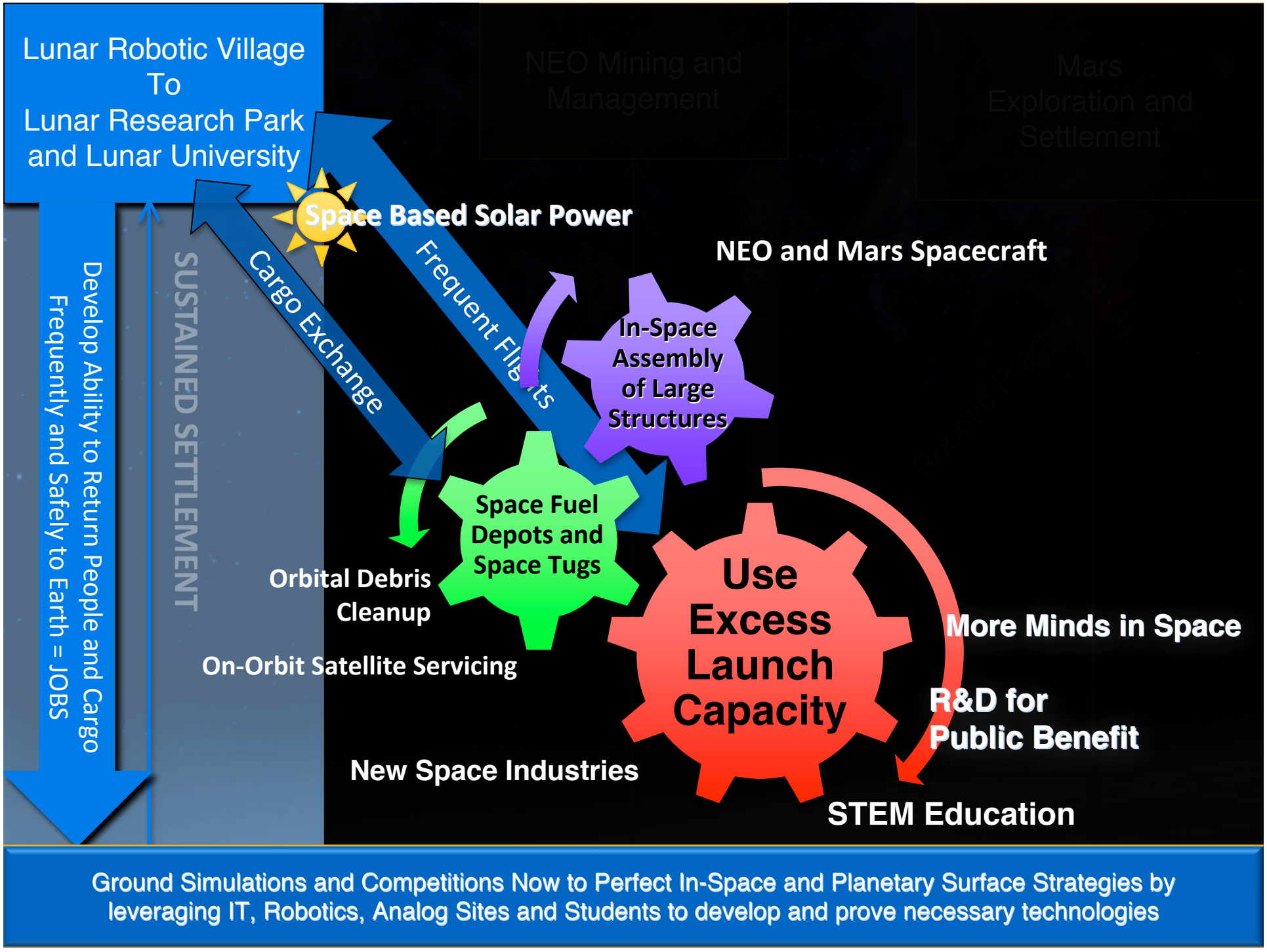
"Over this weekend, NASA just held a competition in California with $750,000 in prizes for anyone in America who could move the most "regolith" --- or moon dirt --- with a robot. Twenty-three teams competed.

The winning team is "Paul's Robotics". Paul is a college student at Worcester Polytechnic Institute in Massachusetts.

He heard about the competition from a high school teacher.

Now that is inspiring."


Lunar Robotic Village
To
Lunar Research Park
and Lunar University
NEO Mining and
Management
Mars
Exploration and
Settlement
Ground Simulations and Competitions Now to Perfect In-Space and Planetary Surface Strategies


Lunar Robotic Village
To
Lunar Research Park
and Lunar University
NEO Mining and Management
Mars Exploration and Settlement
Space Based Solar Power
Cargo Exchange
Frequent Flights
NEO and Mars Spacecraft
In-Space Assembly of Large Structures
Space Fuel Depots and Space Tugs
Orbital Debris Cleanup
On-Orbit Satellite Servicing
Use Excess Launch Capacity
More Minds in Space
R&D for Public Benefit
New Space Industries
STEM Education
SUSTAINED SETTLEMENT
Develop Ability to Return People and Cargo Frequently and Safely to Earth = JOBS
Ground Simulations and Competitions Now to Perfect In-Space and Planetary Surface Strategies by leveraging IT, Robotics, Analog Sites and Students to develop and prove necessary technologies


TRANQUILITY SHORES
INDUSTRIAL PARK
LUNOX CORP.
EDC
He3 LTD.
LUNACOMM INC.
LUNOX
LUNARIJ.
THE NEW SOURCE FOR RESEARCH,
because we will not cease our exploring.
Pat Rawlings '89

Sustainable Settlement Beyond LEO

An Exciting Future with Many Participants

Human Space Flight and Exploration

(1) The ISS, technology developments … and follow-on transportation systems … **form the foundation of initial capabilities for missions beyond low-Earth orbit to a variety of lunar and Lagrangian orbital locations**…

(2) These initial missions and related capabilities should be utilized to provide operational experience, technology development, and the placement and assured use of in-space infrastructure and in-space servicing of existing and future assets

(Excerpts from PL 111-267 Sec. 203(a))

Commercial and International

"It is critical to identify an appropriate combination of NASA and related United States Government programs, while providing a framework that allows partnering, leveraging and stimulation of the existing and emerging **commercial and international efforts in both Earth space and the regions beyond**."

(Excerpts from PL 111-267 Sec. 2(11))